JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. 24 MAY 15, 1934 NO. 5

MATHEMATICS.—*Flatland: Not a romance but a necessary expedient.*[1]

O. S. ADAMS, Coast and Geodetic Survey.

The Philosophical Society of Washington has been in existence long enough to have certain well-established customs and traditions. One of these is that an expiring president may have the right and in fact has the duty thrust upon him of singing his swan song before passing into the discard. Another tradition is that this president may have the privilege of speaking upon any subject he may choose, and without consulting the all-powerful communications committee. The subject chosen may be one connected with the work of the speaker or it may be merely a hobby in which he is especially interested. Before entering on a discussion of the subject in hand, I shall give a short history of the way in which my interest in it was aroused.

Immediately after we entered the World War, the subject of map projections came into great prominence. It was reported that the maps in the war zone in France were constructed on the Lambert conformal conic projection with two standard parallels. At once the Army and Navy officials were anxious for information about such projections, how they were computed, how constructed, and what were their special properties. At a meeting of such officials Major Bowie, chief of the Division of Geodesy of the Coast and Geodetic Survey, stated that he had men in his division who knew all about such matters. The next day he called me into his office and told me it was up to me to substantiate his statement. As a matter of fact my knowledge of such subjects was very hazy if not altogether non-existent. However I immediately set to work consulting such authorities as I could find who dealt with the subject. I at once found that there was no adequate discussion of either the Lambert projection or of map projections in general in existence in the English language. One had to

[1] Received February 8, 1933. Address of the retiring president, delivered before the Philosophical Society of Washington, January 6, 1934.

consult works in either French or German to get any real grasp of the subject. I was at once struck with admiration by the skill of Johann Heinrich Lambert in devising the projection and by the elegance and generality of the treatment of Gauss and LaGrange. Ever since that time the general subject of map projections has been one of my hobbies and an avocation in which I always have a lively interest.

After getting a clear grasp of the general theory of the projection, it was difficult to determine from the meager reports that we had just what the French were doing in their practical construction of the maps in France. Mr. Deetz, one of our experienced cartographers, wrote a publication on the subject of this projection in which I gave some account of the general theory. With regard to its specific use in France we had to make some guesses that were later shown to be not exactly in accordance with the usage in France. It was at this time that I gave a paper before this society on the subject of the Lambert projection. Much interest was manifested at that time because it was a subject of much practical import to those who were destined to take part in the war.

This then was the occasion of my introduction to the general field of map projections. From that day to this my interest in this line of work has remained unfailing and I shall now take it upon myself to inflict some of my enthusiasm upon you. I shall not however trouble you with elaborate mathematical formulas, but I shall endeavor to convey some ideas to you on the subject that may be found of some interest and perhaps of some use.

Places on the earth's surface are located by latitude and longitude; that is, they are assigned a definite position in the network of meridians and parallels that are conceived of as covering the surface of the earth. For every point there is a unique latitude and longitude that applies to that point and to no other. A map projection is an orderly arrangement of two sets of lines or curves, one set to represent parallels and the other set to represent the meridians. They must be ordered by some law because they must have a sequence ordered as are the meridians and parallels themselves. This orderly arrangement may come from direct geometric projection or it may be expressed in mathematical terms. Of course all projections can be stated in mathematical terms, but sometimes a projection is more directly in evidence when considered as a true geometric projection. It is rather unfortunate that all possible schemes are called projections for in some cases it is rather difficult to interpret them in the way of geometric projection.

OSCAR S. ADAMS
President, Philosophical Society of Washington
1933

The difficulty that we have to face in any method of projection is due to the fact that the earth's surface is a curved spheroidal surface and consequently no part of it can be flattened out in a plane without distortions. There is no such thing as a perfect map of any part of the earth's surface. In wrestling with problems of this nature we may wish that the earth were flat, as some religious sects contend that it is, or at least that it were a developable surface such as a cone or a cylinder, but if either of these conditions were so I fear we should as a consequence be plagued with greater evils. We might better "bear those ills we have than fly to others that we know not of."

Since the spheroid is not a developable surface and cannot be represented on a plane accurately in all parts, any map must be a compromise between the various desirable properties. There are, in the main, four things to be considered in regard to any map in question. These are:

1. The accuracy with which a projection represents the scale along the meridians and the parallels.
2. The accuracy with which it represents areas.
3. The accuracy with which it represents the shape of the features of the area included.
4. The ease with which the projection can be constructed.

The scale of a map in a given direction at any point is the ratio which a short distance measured on the map bears to the corresponding distance upon the surface of the earth. The definition must be limited to short distances, because the scale of a map will generally vary from point to point; in other words we must limit ourselves to small elements of length in the way that is familiar to every beginner in the calculus.

We must be careful, in comparing distances, to choose directions that really correspond to each other upon the earth and upon the map. The meridians and parallels on the earth intersect everywhere at right angles; but there are many map projections in which the corresponding lines do not intersect at right angles. In such projections, two directions at right angles on the earth would not necessarily correspond to two directions at right angles on the map. We can avoid confusion if we confine ourselves as much as possible to the consideration of the scale along the meridians and parallels of the map, which necessarily correspond to the meridians and parallels on the earth.

We should like to have the scale of the map correct in every direction at every point. If this could be done, the plane map would be a

perfect representation of the spheroidal surface of the earth. Since this is impossible, the scale cannot be correct in all parts of the map. We are, however, able to choose some one direction and hold the scale constant in that direction; as, for instance, along the meridians or along the parallels. When this is done, the scale in other directions will be wrong at nearly all points.

In what is called the zenithal equidistant polar projection, the scale is constant along the meridians. We denote the scale along the meridian by k_m; in this case $k_m = 1$; that is, it is constant. We denote the scale along the parallel by k_p; in this projection then $k_p = z/\sin z$ which is a variable quantity, z being the angular distance from the pole.

An orthogonal polar geometric projection on the plane of the equator holds the scale constant along the parallels. In this case $k_m = \cos z$ and $k_p = 1$. The distortion of scale in this projection is more noticeable than in the case of the equidistant projection, and, in fact, it is greater as well as more self-evident. This is approximately the way a map drawn on a globe would appear when looked at from a great distance. Also, it is about the way that the surface of the moon looks to us. Of course the point from which geometric projection lines would have to be drawn must be an infinite distance away since the projecting lines are all perpendicular to the mapping plane. However for practical purposes the distance of the moon from the earth may be considered as belonging to the junior order of infinities. Considered by and large, the best we can do for our satellite is to represent its surface on such a projection since it persists in turning the same face to us at all times.

In the general theory of projections there are two classes that are much used in the actual construction of maps. These are what are called the conformal projections and the equal area projections. In the conformal projections the scale is constant in all directions for infinitesimal distances at a given point. In consequence of this, the angles formed by curves on the earth are preserved in their projections on the map. Since the meridians and parallels on the earth intersect at right angles, the lines or curves representing them on the map must also intersect at right angles. In all such maps, there must necessarily be points at which this preservation of angles breaks down unless the projection passes off to infinity. Even there, if we choose to consider infinity as a point, the conformality fails. In the well known Mercator projection, if we look upon the meridians as meeting at infinity they will all meet at zero angle since they are represented by parallel straight lines.

An equal area projection is one in which the ratio of area is constant for all parts of the map; that is, a square inch in one part of the map will represent the same area on the earth that a square inch in any other part of the map would represent. Of such a map we could say in general that a square inch of the map represents a certain number of square miles on the earth. The ratio of area is held constant by making the ratio of length vary at a point in different directions. If the scale is too great in one direction there must be other directions in which it is too small if the ratio of area is to be maintained constant. In a great many equal area projections the meridians and parallels of the map do not intersect at right angles. On the other hand, if they do so intersect, the scale ratios along the meridians and along the parallels are reciprocals of each other; that is, $k_p k_m = 1$.

One of the best known conformal maps is the one based upon the Mercator projection. This is frequently spoken of as a projection upon a cylinder tangent at the equator. This has caused many to think of it as a perspective or geometric projection upon the cylinder with all of the projecting lines radiating from the center of the sphere. I am acquainted with a work issued by two university professors in which this statement is made and I have heard the same statement made by others who should know better. In the Mercator projection of the sphere the scale increases as the secant of the latitude; in the cylindrical perspective projection the scale along the meridian increases as the square of the secant of the latitude. The distance from the equator of any point on the map would be given by $s = a \tan \phi$; hence the most elementary knowledge of the calculus would show that

$$\frac{ds}{ad\phi} = \sec^2\phi.$$

Now in the Mercator projection the arcs of all parallels are kept equal to the same arc on the equator; hence the scale in the longitudinal direction is equal to sec ϕ and since the scale is constant at a point, the scale along the meridian at the point is also equal to sec ϕ and not $\sec^2\phi$ as in the perspective projection. It is thus often misleading to speak of the tangent cylinder in connection with the Mercator projection.

The stereographic projection is one of the oldest projections that is still in use. It is said to have been used by Hipparchus for a map of the celestial sphere as early as 130 B.C. This is a true perspective or geometric projection from a point diametrically opposite to the point of tangency of the mapping plane. In the polar stereographic projection when the north pole region is being mapped, the south pole is

the point from which projecting lines are drawn. This projection is a conformal one and hence this class of projections was one of the earliest to be introduced. The point of tangency can be anywhere on the sphere so that the neighborhood of any place can be chosen as the center of the map. When the point of tangency is on the equator, we have what is called the meridian stereographic projection.

The equal area projections are useful when it is desired to preserve the ratio of areas on the map the same as they are on the surface of the earth. They are thus of great importance in showing statistical data in which the relative amounts of area in separate parts enter into the conception.

The Lambert zenithal equal area projection is one in common use in atlases to represent a hemisphere. In the polar projection $k_m = \cos z/2$ and $k_p = \sec z/2$ illustrating the relation $k_m k_p = 1$.

Fig. 1.—Parabolic equal area projections of the world. Compiled and arranged by C. H. Deetz, U. S. Coast and Geodetic Survey.

The Bonne projection is one that is frequently used for maps of Asia. It belongs in the equal area class. Conical equal area projections are very important, especially the Albers projection. The Geological Survey has issued a wall map of the United States with this projection as a basis. Tables for the same were issued by the Coast and Geodetic Survey which were computed under my direction. In late years the sinusoidal projection has been much used for general maps. A somewhat similar and, in some respects, a more pleasing projection is the one called the parabolic equal area projection. This projection is so called because the meridians are arcs of parabolas. It was first suggested by Lieut.-Col. J. E. E. Craster of England and I made some computations from which Mr. Deetz of the Coast and Geodetic Survey constructed an interrupted map of the world. The Carnegie In-

stitution of Washington is using the same projection for a general map of Pan-America for use in studies in genetics.

Many of the equal area maps are much distorted in shape and some of them remind one of images seen in comic mirrors. Werner's heart-shaped map of the world is one such; also Collignon's triangular map of the world and even the cylindrical equal area map.

We should not fail to mention the equal area world maps within an ellipse. We have Mollweide's map with straight line parallels and the Hammer-Aitoff map in the same ellipse but with curved parallels. A rather curious map of this kind is the transverse Mollweide computed by Col. Close of England.

The surface of the earth adopted for mapping purposes is that of an ellipsoid of revolution. This is a more complicated surface than that of a sphere. Latitude upon the ellipsoid is the angle made by a normal to the surface with the plane of the equator. These normals in general do not pass through the center of the ellipsoid. If one wants to compute projections by taking into account the ellipticity of the earth the formulas become quite complicated. In the discussions of the Lambert conformal conic projection, it is usually stated that the geocentric latitude can be used since it differs but slightly from what may be called the conformal or isometric latitude. In the early computations that I directed and made, this latitude was used. My attention was drawn to the question of the magnitude of this difference by an inquiry to the Office of the Survey from the venerable James Pierpont of Yale University. He inquired at what latitude this difference was a maximum and what was the approximate size of the difference. I was called upon to answer the query and my interest was thus aroused. All authorities stated that if this isometric latitude were known then all conformal projections could be computed directly from this conformal or isometric sphere. I conceived the idea of taking all different kinds of latitude for which there was any use and developing the differences between them and the geodetic latitude in terms of the sines of the multiple arcs. In all, five kinds of latitudes were thus treated. Tables were then computed that can be used for any future computations.

The isometric latitude is then a conformal projection of the spheroid on the sphere. A conformal projection of this isometric sphere on the plane therefore gives a conformal representation of the spheroid on the plane.

In analogy to this, I had the happy inspiration to project the spheroid on a sphere of equal surface so that the projection was

characterized by equal areas in all of its parts. I had never seen this referred to by any authority; so I gave the name of *authalic* latitude to this conception after Tissot who employed the term *authalique* for all equal area projections. The equivalent sphere is also called the *authalic* sphere.

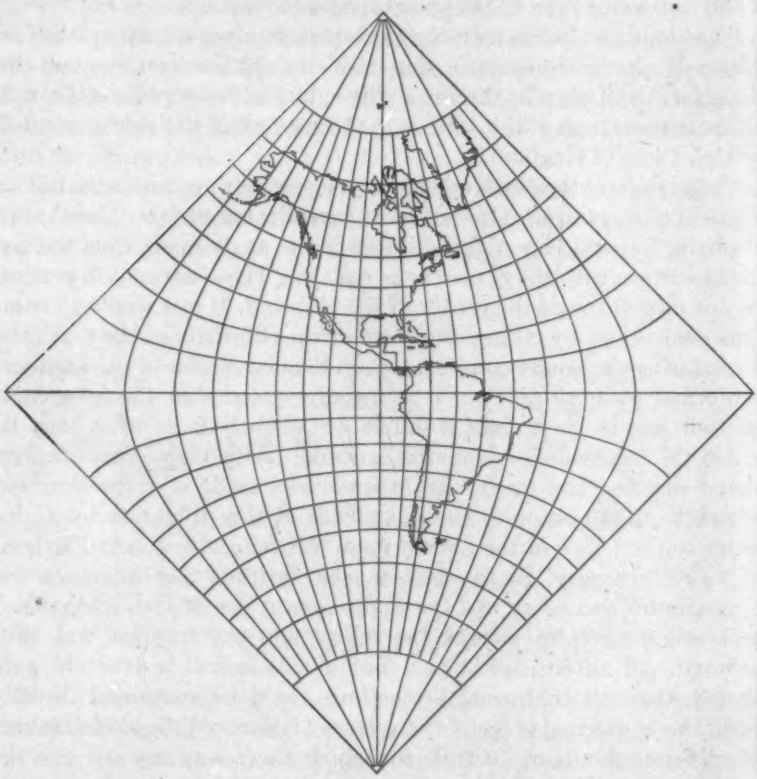

Fig. 2.—Conformal map of the Western Hemisphere in a square.

Another important latitude is the one called the rectifying latitude. A sphere is chosen such that the length of a meridian on it is exactly equal to the length of a meridian on the spheroid. Then corrections to the geodetic latitudes are computed so that each parallel on the sphere is the correct distance from the equator. With these latitudes any arc of the meridian can be computed readily and accurately.

I shall now give some account of a series of projections with which

my name is more directly connected since they are the result of my own investigations. In 1864 H. A. Schwarz proved that a circle could be mapped conformally upon a regular polygon of n sides by means of the integral

$$w = \int_0^x \frac{dx}{(1-x^n)^{2/n}}.$$

This was proved by the theory of functions of a complex variable, and its validity is readily seen to follow from consideration of integrals in that branch of mathematical analysis. Two examples of the results of this theorem had been made, one by C. S. Peirce in 1877

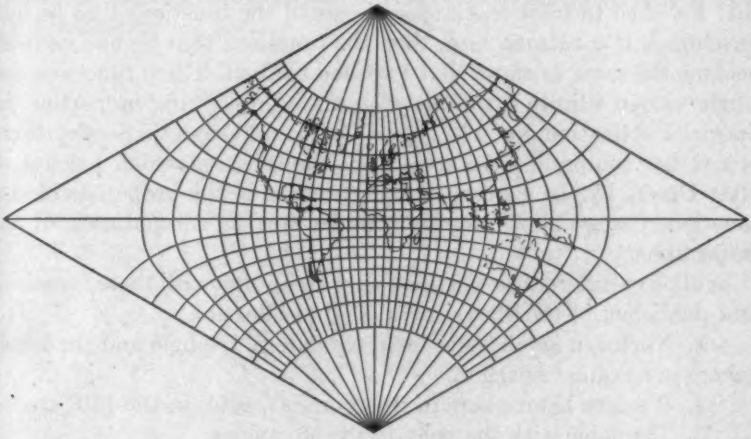

Fig. 3.—Conformal map of the world in a rhombus.

at that time a member of the Coast and Geodetic Survey and one by Lieut. Guyou of France. Both of these depended upon the integral when $n = 4$, and hence the maps were enclosed in a square.

Now Gauss and LaGrange had proven that any projection derived by any function of the complex variable for any conformal projection would of necessity give a new conformal projection. Moreover since Gauss established the theorem in all generality, when such projections are formed, we do not need to investigate whether they are conformal. Their conformality follows from the general theorem.

I saw at once that if we could form an algorithm for the computation of the integral

$$w = \int_0^z \frac{dz}{(1-z^3)^{2/3}}$$

we should have a circle mapped within a triangle, and by further manipulation we could map the circle or a hemisphere within a rhombus with one pair of angles 120° and the other pair 60°. One could, of course, develop the integral in a series and use for z the complex variable of the stereographic projection, but this is a laborious process since the series does not converge very rapidly.

As an aid in the formation of computation methods, I decided to invert the integral and to develop the properties of z as a function of w. In 1890 Prof. A. C. Dixon of Trinity College, Cambridge, published a paper *On the doubly periodic functions arising out of the curve* $x^3+y^3-3\alpha xy=1$. On consulting this article, I saw at once that the function that I wished to treat was a special case of the functions that he had developed. If α became zero, then the functions that he had devised became the same as those that I wished to treat. These functions are single valued elliptic functions with many interesting properties. In Special Publication No. 112 of the Coast and Geodetic Survey there is a rather comprehensive account of the function which I denoted, after Dixon, by the symbol *sm w*. By means of the properties of this function, I was able to devise formulas for the computation of the projections.

In all, five different projections were computed with these functions and published in the above-mentioned publication:

1. Northern hemisphere in an equilateral triangle and the whole sphere in a regular hexagon.
2. Western hemisphere in the rhombus, poles in the 120° angles.
3. The same with the poles in the 60° angles.
4. Northern hemisphere in the rhombus, pole at the center of the rhombus.
5. Rhombic projection of the world, poles in the 120° angles.

A projection of the western hemisphere within the Peirce and Guyou square and with the poles in a pair of the angles was also included in the same publication.

A further illustration of the Schwarz integral was computed, based upon 6 as the value of n. This gives the northern hemisphere in a regular hexagon, and the rest of the world mapped on the points of a six rayed star.

As a final example of the use of elliptic functions, for maps, the world was conformally mapped in an ellipse similar to the Mollweide ellipse. This was done in two steps; first a computation was made for a projection within an elongated rectangle. A map was constructed on this grid to show what it was like. By use of a function of the complex

variable of this projection, the final map was made. This map has been reproduced in the recent important French work on projections by Driencourt and Laborde as an example of a planisphere in this ellipse that does not have such violent distortions of shape as have the others mapped in the same ellipse.

Before leaving this subject I wish to call attention to a conformal projection that was computed for Mr. B. J. S. Cahill, an architect of Oakland, Calif. Mr. Cahill calls this projection a butterfly map of the world. It is easy to see that the projection depends on the same elliptic function that I have used for the various other maps within a rhombus. The map is strictly conformal and is computed on the most rigid mathematical basis.

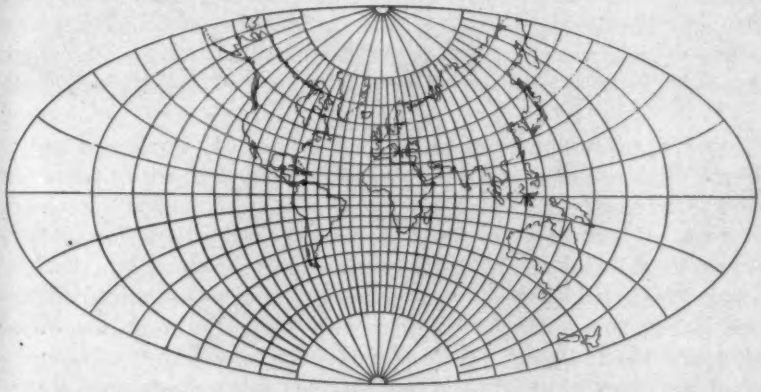

Fig. 4.—Conformal map of the world in an ellipse.

Besides this map, I have computed for Mr. Cahill what he calls his gnomonic variant of the butterfly map. This is in fact a gnomonic projection or a geometric projection from the center of the sphere upon a circumscribed regular octahedron; then this octahedron is split along the edges and spread out into the plane in the butterfly style. In this projection a great circle on the sphere becomes a straight line on the map. Unfortunately we can only consider the earth as a sphere in making such a map. It might be thought that we could first project the ellipsoid on the sphere in such a way that the geodetic lines on the spheroid would become great circles on the sphere. It is to be regretted that this cannot be done. It has been proved that geodetic lines on an ellipsoid cannot in general be projected into straight lines in the plane. Now if such a projection could be made on the sphere the geodetic lines would become straight lines in the plane,

but this is contrary to what has been proved. However for the usual mapping purposes it is sufficiently accurate to consider the earth as a sphere.

I wish here to call attention to an interesting feature in making certain types of maps. I have spoken of the conformal projection of the spheroid upon the sphere as forming a cartographic expedient that is very useful in practice. In addition to this we can map the whole sphere conformally on the half sphere and then project this hemisphere upon the plane within a circle. This is done in the case of Lagrange's projection in which case we can imagine a cut made along a

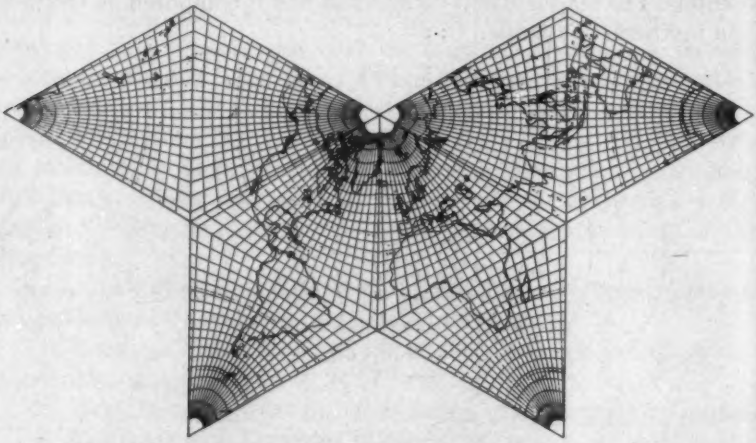

Fig. 5.—Gnomonic map of the world on a circumscribed octahedron.

meridian from pole to pole and then the surface shrinking conformally until the whole surface covers only a half of the sphere. This hemisphere projected conformally on the plane as a meridian projection gives Lagrange's projection of the world within a circle.

As an interesting experiment, I tried cutting along the equator half way around and then causing the surface to shrink conformally until only the half sphere was covered. This hemisphere could then be projected into the plane in a circle as was done in Lagrange's projection. However I computed the same in a square with the poles situated on a diagonal symmetrical with respect to the center. Other arrangements either in a square or in the rhombus that I have already used extensively could be made. It would be interesting to map it in the ellipse that I have already used, placing the poles on the major axis symmetrical with respect to the center. Sometime,

possibly when I have too much leisure on my hands, I may try such experiments.

After the publication of the work on *Elliptic functions applied to world maps*, I sent a copy to Professor Dixon explaining that his article in the *Quarterly Journal of Mathematics* was the source of my inspiration in the subject. I received a very pleasing letter in reply in which he said that as far as he could check up he thought that I was the only one who had ever looked into his article farther than reading the title. He congratulated me very heartily on finding some use for his work.

Using Lagrange's projection of the world within a circle as a basis, we can compute a conformal map of the world within a two cusped epicycloid. This has been done by Prof. August and I have computed a table of coordinates for the same. It could be constructed graphically after the Lagrange projection has been made to serve as a basis, but better construction work can be done by the use of x and y coordinates.

Just recently a new use for some of the more important projections has come to the fore. In this country the Coast and Geodetic Survey has some 40,000 miles of arcs of triangulation. Since these cover great stretches of territory all of the work has to be computed by means of latitude and longitude. The actual surface of the earth is, of course, very irregular but the ideal sea-level surface approximates very closely to the surface of an ellipsoid of revolution. Such a surface has been adopted as the basis of geodetic operations and all of our triangulation is computed on this ideal surface in terms of latitude and longitude and azimuths and lengths.

Now local surveyors in cadastral surveys and surveys for public works are interested in general in much more limited areas. A demand arose from engineers throughout the country for the establishment of plane coordinate systems for regions in which such work was to be done. It has been the custom of most such engineers to establish local systems for their various projects. This led to much confusion when it was desired to extend the work so that various projects overlapped. It was found very troublesome to coordinate the work with what had already been done. Also these local systems are quite limited as to the distance that they can be carried without troublesome discrepancies entering into the work.

It might be said that such engineers should resort to geodetic computations. This is easy to say and we of the Coast and Geodetic Survey have been saying it for many years. However, the trouble is

that "you can lead a horse to water but you can't make him drink." Geodetic computations are rather complicated and, though they are easy enough when one is used to them, it is nevertheless difficult to get the general public to use them. So, "if the mountain will not come to Mahomet, then Mahomet will go to the mountain" and that is exactly what we have done.

In response to this demand for coordinate systems that could be applied to more extensive areas and would still give exactness in computation, I was requested by Major Bowie to look into the matter to see what could be done. The first request came from the engineers of the Public Works Administration of North Carolina. The Coast and Geodetic Survey in cooperation with this state was just completing a network of triangulation over the state that gave excellent control for any engineering work within the region. The state officials were making extensive surveys for roads and other public works and they wanted this control data put on a more practical basis for use by their engineers and the request was a very logical one. All Federal control data should be put in such form as to be most readily available for the engineers who wish to use such control.

After a careful study of the situation we recommended a statewide system of plane coordinates based upon the Lambert conformal conic projection with two standard parallels. Since this gives one system for the entire state, any work done in any part of the state that is based on the general control system is at once coordinated with the work in any other region of the state. Scale discrepancies are found in such an extensive system, but they are definite variations that can be taken into account and computations can be made upon the grid with an accuracy far within the accuracy of ordinary engineering work.

With careful use of the scale factors geodetic accuracy can be obtained. This system has been in use in North Carolina for some time and all the surveys that are being made at the present time are computed directly on this grid making use of the scale factors in all cases. Work of this kind is very active in that state under the state relief appropriations.

After completing the computation for North Carolina a similar computation was made for Long Island. In this system owing to the limited extent in latitude the scale variations could be kept below one part in 100,000 for the island proper with most of it as good as one part in 200,000. This is within the accuracy of even geodetic control,

so it will not be necessary to trouble about the scale factors except for the most exact computations.

As a next experiment, a system for New Jersey was devised, based upon the transverse Mercator projection. This is the well known Mercator projection with its axis turned to an east and west direction in which the coordinates are related to a central meridian in the same way that the ordinary Mercator projection is related to the equator. To give a balance of scale in the system, the scale was reduced one part in 40,000 along the central meridian. This makes the scale exact along two small circles parallel to the central meridian at a distance from it of approximately 28 miles. We might think of this as an intersecting cylinder instead of a tangent cylinder but we have advised against this cylindrical conception of the projection. It is similar to what we should have in the ordinary Mercator projection if the scale were held exact along parallels approximately 28 miles north and south of the equator.

Formulas for the direct computation of coordinates from geodetic positions have been devised for both systems of coordinates. These are comparatively simple and the computations can be made by anyone familiar with the use of logarithms and trigonometric tables. The state tables are made to include all of the data necessary for such computations. After all geodetic stations have been computed in terms of x and y coordinates on the grid, all further computations can be made directly in terms of plane coordinates.

Single systems have also been computed for Maryland, Tennessee and Massachusetts on the Lambert projection and for Delaware on the transverse Mercator. For Iowa, Ohio and South Carolina two systems on the Lambert have been used with the division between them determined by county lines. This will keep each county on a single system. In Florida it was found desirable to employ three systems; two transverse Mercators for the north and south section and a Lambert for the western portion at the north. Georgia, Alabama and Mississippi have been divided into two systems, each on the transverse Mercator, and further systems will be computed just as rapidly as possible until practically all of the states are provided with such aids to accurate computation on the plane.

In our rapid survey of the various and sundry possibilities for flatland construction, we have seen that the ideal map has proved as elusive as Sarah Gamp's Mrs. Harris. The best we can do is to choose the form of projection that is most suitable for the particular purpose that the map is to serve. We should be careful in any case not to draw

conclusions from a map that are not justified by the facts. Even a man in the Coast and Geodetic Survey inquired why ships and aeroplanes go north by way of Newfoundland in going from New York City to England. He said "Why not go straight across and save a lot of distance?" He was thinking in terms of a Mercator projection and not in terms of a gnomonic as should be done in all such cases. A gnomonic map will show that the great circle from New York City to Liverpool passes through Massachusetts west of Boston and over Newfoundland well towards the northern portion. Any route south of this line is necessarily a longer one. The shortest distance from Seattle to Yokohama passes through the Aleutian Islands. That from Panama to Yokohama passes far inland through the states, entering the Pacific near the mouth of the Columbia River.

Even a President of the United States, in his letter of congratulation to an explorer of arctic regions, felicitated him for the discovery of an island westward of the pole. I fear it would tax the ingenuity even of a president to explain in what way any point on the earth *could* be *westward* of the pole. We should attempt to judge things not as they seem but as they are.

I am glad to note that a number of moderate priced globes have appeared on the market in the last few years. This is a matter that I advocated in Special Publication No. 68 which appeared some years ago. Whether my advice has been a factor in causing this new movement I am not able to say, but I do know it is an important move. Even a small globe, though badly fitted together, will give a truer picture of the relative arrangements of the features of the earth than can be secured from the best of maps.

We may not be intentionally misleading as is described by Dean Swift:

> "So geographers, in Afric maps,
> With savage pictures fill their gaps,
> And o'er uninhabitable downs
> Place elephants for want of towns."

Nevertheless, our best efforts are often misinterpreted through lack of insight on the part of the user. Let us all try

> "To know what's what, and that's as high
> As metaphysic wit can fly."

GEOLOGY.—*Supplementary notes on Pleistocene glaciation in the Great Basin.*[1] ELIOT BLACKWELDER, Stanford University.

Since the publication of my paper on the glaciation of the Sierra Nevada and Basin Ranges,[2] I have extended my studies among the ranges of Utah, Nevada, and eastern California. The results, so far as they concern glaciation, are here presented.

Stansbury Range, Utah.—A view from Grantsville affords clear evidence of glaciation near Mt. Deseret (10,250 feet). The topographic forms show that several glaciers occupied canyons in the eastern slope, probably during the Tahoe glacial stage, and descended about half way to the base of the range, leaving moraines of considerable size in the bottoms of the valleys. It seems probable also that the cirques made at that time were refreshed by glacierets during the later Tioga stage. Marsell,[3] who has climbed Mt. Deseret, confirms this opinion and adds the information that several tarns were found in the cirques.

Oquirrh Range, Utah.—According to Marsell, Mt. Lowe (10,200 feet) formerly had glaciers on its eastern slope. The freshness of the cirques indicates the Tioga as well as the Tahoe stage.

Deep Creek Mountains, Utah.—This short range on the western edge of Utah reaches an altitude of 12,100 feet. My only information regarding its glacial history is from Marsell who states that deep cirques and glacial canyons, which he saw from the adjacent plain, indicate vigorous glaciation in both Tioga and Tahoe stages. This range is probably very similar to the Snake Range, farther south, in both form and glacial history.

Pilot Range, Nevada.—A valley head on the northeast side of Pilot Peak suggests by its form and rugged surface a cirque of Tahoe age, but the locality has not been examined closely.

Independence Range, Nevada.—About fifty miles north of Elko, a small group of glaciers once clustered around Jack's Peak (altitude about 11,000 feet). In the Tahoe stage a glacier descended McAfee canyon, on the eastern slope, about 4½ miles and built a moraine on the edge of the plain. The terminal portion has since been eroded away and replaced by a wedge shaped alluvial fan, but the old lateral moraines extending down to the base of the range are still conspicu-

[1] Received Jan. 22, 1933.

[2] BLACKWELDER, ELIOT. *Pleistocene glaciation in the Sierra Nevada and Basin Ranges.* Geol. Soc. Amer. Bull. 42: 865–922. 1931. In this paper four glacial stages are recognized as follows, beginning with the oldest: 1, McGee; 2, Sherwin; 3, Tahoe; and 4, Tioga. The last of these is believed to be equivalent to the latest Wisconsin moraines of northern United States.

[3] MARSELL, R. E. University of Utah. Oral Communication.

ous. Two smaller glaciers occupied unnamed canyons immediately to the north and another across the ridge to the south. In the Tioga stage there were apparently only three glaciers in this group and the largest was not much more than a mile long. Their existence is indicated by the presence of tarns and by the freshness of the cirques and moraines. Farther south there is similar evidence of two stages of glaciation at the heads of Pratt and Foreman Creeks. No doubt when the western slope of the same mountains is examined evidence of similar glaciation will be found there also.

Along Foreman Creek at least there are two well defined sets of gravel terraces—one 10 feet above the modern flood plain and the other 36 feet. Reasoning from better known terraces elsewhere in the West, I infer that the lower terrace was formed as a valley train at the time of the Tioga glacial advance and the upper terrace during the Tahoe stage.

When these mountains are more carefully examined it is probable that evidence of still older glacial stages will be found.

Jarbidge Mountains and Copper Mountain.—As the highest peaks of this group are, if anything, somewhat higher than Jack's Peak, it is almost certain that they were glaciated likewise. Distant views through a hazy atmosphere were not sufficient to permit me to draw satisfactory inferences.

Ruby Mountains.—The northern part of this range lying between Wells and Secret Pass was formerly known as the East Humboldt Range. Its summits rise to elevations of 10,500 to 11,300 feet but its relief is greater and its slopes steeper than those of the Independence Range. Many of the larger canyons on both flanks were glaciated in both Tahoe and Tioga stages. Those on the west side were apparently the largest—5 to 7 miles long in the Tahoe stage—but did not reach the plain. On the east side those of the same age extended down to the base of the range. The glaciers in Leach and Steel canyons appear to have been the longest—about 3 miles. As usual, the older (Tahoe) terminal moraines have been eroded away, leaving only the lateral ridges. Excellent cirques, still ragged and bare, and small fresh moraines clearly indicate glaciers of the Tioga stage, but none of them came far down the mountain sides South of Johnson Creek, on the eastern slope and Boulder Creek on the west side, no definite evidence of glaciation was observed.

From Secret Pass the main body of the Ruby Range extends southward about 60 miles. Its crest is above 10,000 feet through perhaps half of its length and culminates in Lamoille Peak (altitude

11,128 feet). The eastern slope of the range, being steep and short, afforded less catchment area for snow. Perhaps for this reason none of the glaciers reached the base of the range even in the Tahoe stage, although the Dawley Creek glacier came within about half a mile of the plain. Most of the larger canyons between Lutts Creek and Dawley Creek display the usual moraines and cirques, indicating glaciation in both the last two stages.

On the western slope large glaciers descended Lamoille (13 miles long) and Rattlesnake canyons during the Tahoe stage and extended out upon the adjacent plain. Several intermediate glaciers reached the base of the range. Even in the Tioga stage glaciers several miles long occupied the heads of these canyons.

No clear evidence of glaciation has been observed south of Harrison Pass and nowhere in the range has clear evidence of pre-Tahoe glaciation been found.[4]

During a moister epoch, which probably coincided with the last glaciation in the mountains, an extensive lake occupied the basin east of the Ruby Range. Conspicuous gravel embankments around the northern and eastern sides of the lake and occasional wave-eroded cliffs indicate a lake which was at one time at least 120 feet deep. It has now dwindled to two shallow lakes, of which the northern one is little more than a marsh.

Toyabe Range, Nevada.—The Toyabe Range, culminating in Arc Dome, at an elevation of 11,775 feet, is somewhat higher than the Ruby Range and yet reveals to cursory examination surprisingly little evidence of glaciation. At the head of a canyon on the east slope about 12 miles south of the Lincoln Highway, obscure cirques now much clogged with talus, suggest glaciation in the Tahoe stage only. The canyons around Arc Dome, west of Round Mountain, seem to have harbored glaciers several miles long during the Tahoe epoch, but the cirques are now so subdued that I am disposed to doubt that there were any glaciers there in the Tioga stage. Apparently the most favorable place for glaciers in this range is in the deep canyon south of Arc Dome, a locality not yet examined.

Shoshone Range, Nevada.—These mountains are a northward continuation of the Toyabe Range but are generally somewhat lower in altitude. As seen from the railroad near Beowawe, the highest mountain in this group has a cirque-like hollow on its northeast side that strongly suggests glacial action of Tahoe age.

[4] As mentioned in my earlier paper (Op. cit., p. 911), some indications of till of the Sherwin stage were found west of the mouth of Lamoille canyon, at the western base of the range.

Wassuck Range, Nevada.—This range was evidently too low to induce vigorous glaciation. The only evidence I have observed is a cirque-like excavation on the east side of the highest peak, Mt. Grant (elevation 11,303 feet) which suggests a small glacier of the Tahoe stage.

Sweetwater Range, California.—Being higher (11,646 feet) than the Wassuck Range, the Sweetwater Mountains were fairly well glaciated at least during the Sherwin and Tahoe stages. Subdued cirques and small moraines suggesting glacierets of Tahoe age have been found at the heads of Desert and Deep Creeks on the western slope. On the east flank ice tongues of the same age were somewhat longer and more numerous. Although the canyons there have not been closely examined, the glacier in Sweetwater canyon appears to have been about 3 miles long and extended more than half way down to the base of the range. The cirques are not ragged and clean enough to suggest vigorous ice action in the Tioga Stage.

Near the head of Deep Creek on the western slope a body of much weathered and eroded old till indicates that a glacier of the Sherwin stage about 3 miles long descended below the 9300 foot contour.

White Mountain Range in California.—Although by far the highest mountain range in the Great Basin (summit 14,242 feet) this range was less severely glaciated than the much lower Ruby Range. Only the northern part of the range, about 22 miles in all, gives evidence of strong glaciation. Small glaciers of the Tioga stage are indicated by fairly clean cirques and suggestions of very bouldery moraines at high elevations. In the Tahoe stage much longer glaciers descended the canyons but none of them approached the base of the range closely. On Perry Aiken Creek, on the east side of the range, a remnant of what is probably the Tahoe stage moraine stands at an altitude of about 6,500 feet, 2 miles back from the margin of the range. No evidence of glaciation has been observed south of Milner Creek on the west slope, or on Iron Creek on the east side.

On both sides of Perry Aiken canyon and near the front of the range, bodies of ancient till, now greatly eroded and weathered, probably represent the Sherwin stage. The distribution of these remnants suggests that the glacier of that age extended out to the adjacent plain. The patches of old till lie upon the tops of ridges which themselves have been carved out of granitic rock. In this locality faulting along the base of the range has introduced complications not usually present. From a brief study of the valley I infer that a thick valley train was aggraded below the terminal moraine of the Tahoe stage. A displace-

ment of nearly 300 feet on a fault along the base of the range then caused this deposit to be deeply trenched, leaving gravel terraces of corresponding height along the sides of the canyon. The large fan at the mouth of the present canyon is therefore probably of late Pleistocene and Recent age. It is still growing by the addition of bouldery mudflows at frequent intervals.

Spring Mountain Range, Nevada.—This southernmost range of high mountains in Nevada attains an altitude of 11,910 feet, but apparently it was too far south to receive snow enough for glaciers during the Tioga epoch. The somewhat excavated heads of the canyons surrounding the highest peak afford a suggestion of glaciation during the Tahoe stage. It is still more probable that glaciers were present in the Sherwin stage, but observational evidence is not yet available.

Panamint Range, California.—Although Telescope Peak reaches an elevation of 11,045 feet no good evidence of glaciation has been afforded by views from the base of the range on either side. However, because of its altitude and geographic position, it seems possible that glaciers were present in the Sherwin stage, but scarcely probable that even small glaciers occupied any of the valley heads during Tahoe time.

Other Great Basin ranges of which the highest peaks reached elevations between 10,000 and 11,000 feet may well have possessed small glaciers during the Sherwin and even the Tahoe glacial stage. Most of these mountains have not been examined for evidence of glaciation. In some, the record will doubtless be obscure, and in others, quite lacking.

SUMMARY

The facts which have been derived from this reconnaissance indicate rather clearly that the distribution and intensity of mountain glaciation are influenced by three factors—latitude, humidity, and altitude. In the mountains of Nevada which attain elevations of 11,000 to 12,000 feet the severity of glaciation decreases steadily from north to south, as would be expected. In northernmost Nevada mountains scarcely 11,000 feet high were inhabited by small but vigorous glaciers of Tioga stage, whereas near the southern end of the state, mountains nearly 12,000 feet high had no glaciers at that time.

The influence of humidity is conspicuously shown by the extensive glaciation of the Sierra Nevada, whereas the equally high White Mountain Range, which lies directly east and therefore in the rain-shadow of the Sierra, had only a few relatively small glaciers.

The Ruby Range illustrates the importance of altitude as a factor. In the section where the peaks range in elevation from 10,500 to more than 11,000 feet every canyon held a vigorous glacier. Farther north along the same ridge, where the highest summits rise to only 9,500 to 10,000 feet, there is little evidence of glaciation.

In keeping with the well known fact that the last three glacial episodes in western United States form a declining series, it is clear that in the Great Basin each successive member of that series could form glaciers only at a higher altitude than the one preceding. In central Nevada the mountains below 11,500 feet developed no glaciers during the Tioga ice stage and those below 10,700 feet none in the Tahoe stage. Much less is known about the Sherwin glacial stage but from the greater extent of the ice lobes of that time it seems probable that an altitude of about 9,500 to 10,000 feet may have been sufficient then to induce glaciation. It seems very improbable that any mountains whose summits are less than 9,000 feet in altitude in northern Nevada or 10,500 feet in extreme southern Nevada will be found to show any evidence of Pleistocene glaciation. It is not to be forgotten that some vertical diastrophic movements have occurred in the region since the Sherwin stage, but available evidence indicates that in most places the increase of relief from that cause has been negligible.

BOTANY.—*Microsporum of cats causing ringworm in man.*[1] VERA K. CHARLES and ALINE FENNER KEMPTON, Bureau of Plant INDUSTRY.[2]

It has been recognized for some time that domestic animals and pets may be a source of danger to man as carriers of disease. A case of ringworm infection transmitted by a cat, which came to our attention in 1933 not only demonstrated this fact but enabled us to work out very definitely the exact stages in the transmission of the ringworm fungus from cat to man. The following is a brief outline of the history of the case.

The first victim we will designate as Case I. In this instance a three-months-old Persian kitten had been acquired, and after having it about 3 weeks the new owner developed a few suspicious spots on the throat. The original owner of the kitten had observed a few dandruff-

[1] Received January 29, 1934.
[2] Acknowledgment is made of the assistance of Dr. L. T. Giltner, of the Bureau of Animal Industry.

like particles on the neck especially on the throat of the kitten, but had attributed their appearance to a slight stomach disorder, which seemed to have been controlled before the kitten was acquired by the new owner, or Case I. The later history of the case proved that a cure had not been effected, but the kitten had been combed and cared for so carefully that no evidence of scurf remained. It is important to note that the kitten's home in both instances was an apartment. As previously mentioned, about 3 weeks after the kitten had been acquired several red, oval to round spots appeared almost simultaneously on the throat, chest, and face, especially around the eyes and shoulders of the new owner. Later the affection spread to all parts of the body. These spots were accompanied by intense itching and the infected area became inflamed and feverish. A microscopic examination of particles of skin from the diseased area revealed the presence of mycelium but no fruiting fungus. Cultures made from dandrufflike particles in the hair produced spores, but no typical lesions developed on the scalp.

Cultures were made on Sabouraud medium from scrapings from the affected parts, and in three days the fungus was fruiting abundantly. As soon as the mycelium was found suspicion was directed to the kitten. The animal was immediately brought to the laboratory and on careful examination showed a few dandrufflike particles. A microscopic examination of this material also disclosed mycelium. Cultures were made on Sabouraud with the result that in three days the fungus was fruiting abundantly. The two cultures, one from the human skin and the other from the cat, proved to be identical.

When the cultures were about ten days old, two healthy short-haired cats were inoculated, one from the human inoculum and one from the strain from the cat. With the latter strain two methods of inoculation were used: (1) hairs from the diseased kitten were placed on a scraped spot of the skin of the cat to be inoculated; (2) a bit of the fruiting fungus was placed on a scraped spot of the skin of the other healthy cat. All inoculations were positive and no difference could be observed in the virility of the two strains. The new owner of the kitten had lived in the apartment for some time before acquiring the kitten; therefore there could be no doubt of the kitten being the source of infection.

TREATMENT

Case I was given intensive and persistent treatment as soon as the cause of the trouble was definitely diagnosed. Daily baths and frequent shampoos were taken with medicated soap containing sulphur

or mercury compounds. The earliest treatment consisted in an application of a 5 per cent solution of salicylic acid in 95 per cent alcohol. The treatment was begun on April 18, and at first there seemed to be evidence of improvement, but about a week later the spots broke out again as small raised lumps around some of the old lesions. Additional new lumps developed even after the infection had run for some time. Treatment was continued once a day or twice when new lesions appeared. Some authorities insist that a 10 per cent solution of salicylic acid is necessary to kill the fungus, but this is very severe and many skins cannot tolerate so high a percentage. An application of 3½ per cent solution of iodine was used quite faithfully for a few days, but the salicylic acid seemed to be more effective. On May 10, treatments were begun with bismuth violet,[3] made according to the following formula: 1 gram of bismuth violet crystals, 10 grams of salicylic acid, and 100 cc. of 70 per cent alcohol. This solution proved too strong, and the percentage of salicylic acid was reduced one-half. This treatment appeared quite effective, but on account of its color the solution is not desirable for ordinary use.

During the latter part of May treatment with an ointment of ammoniated mercury was begun, but as this was a salve it was applied only at night. On June 1, treatment was started with a certain commercial product. This was employed as a spray and was very convenient and satisfactory, as it could be applied several times a day and caused no discoloration. This medicinal spray appeared very effective, but just how much credit it should have is a question, because in all probability the fungus had been weakened or partly controlled by the applications of strong salicylic acid. It is important to repeat that, from the beginning, medicated soap was used regularly for both baths and thorough shampoos. The treatment of the kitten consisted of baths with a 1 per cent solution of orthophenylphenol in cocoanut oil soap. This treatment failed to control the fungus, which increased considerably and spread along the back and shoulders of the kitten. The long thick hair was doubtless partly responsible for the ineffectiveness of the treatment, but other factors entered into the case. The kitten was confined in a small cage in a hot room having a high degree of humidity. These two factors, heat and humidity, were especially favorable to the growth of the fungus. At the end of three weeks the kitten was taken to Pennsylvania by the original owner who reported that the kitten was finally cured, after having spent the summer out of doors.

[3] Formula patented by Dr. Irving S. Barksdale, Greenville, S. C.

DURATION OF THE DISEASE AND SUSCEPTIBILITY

The lesions of Case I were of long duration and great severity. The first spots appeared on April 16 and the spots continued to develop until early August. Even after that period, small red spots developed but soon subsided. During the course of the infection Case I developed over 70 typical lesions, the largest the size of a dime. In addition to the typical lesions, numerous small spots appeared which, however, soon yielded to treatment. Case II, another member of the household, developed lesions in considerable number but much less than Case I. In this instance a lesion developed in the scalp and was very slow in yielding to treatment. A third case was that of a friend who visited the house only once, on April 17, 1933, and held the kitten for several minutes. This case developed one very typical lesion on the neck, which was cured by the use of strong iodine.

There is evidently a great difference in the susceptibility of individuals. The original owner of the kitten had six cats in addition to the kitten so that there was every opportunity to develop a severe case of ringworm. These cats developed the disease but in a much milder form. No typical lesions appeared on the owner, but for some weeks she was troubled with rather hard, red, raised spots on her arms. These spots were too nearly cured when examined to make successful cultures even if the fungus had been the cause of the eruption.

The question of susceptibility or non-susceptibility has been attributed to various factors. E. W. and A. E. Stern[4] conducted experiments on the pH concentration of different remedies and showed that basic dyes are increasingly effective as inhibiting agents as the pH of the media is increased. Gentian violet is a basic dye that is effective, whereas mercurochrome is acid and has been found to be less effective. The question arose as to whether or not the degree of acidity or alkalinity of the human system would have any bearing on the question of susceptibility. Hoping to get a little data on this phase of the subject, a series of experiments was conducted with culture media having different pH concentrations ranging from 4.7 to 7.3. The cultures were fairly uniform in growth, no marked differences being observed.

DETERMINATION AND MORPHOLOGY OF THE CAUSAL ORGANISM

The mycelium observed in the scrapings from the human skin lesions and in the scurf from the kitten was found very sparingly and

[4] STERN, E. W. and A. E. Journ. Lab. & Clin. Med. 14: 1057–1060. 1927.

was hyaline and fine, about 2½ to 3μ in diameter. In the cultures the mycelium was much coarser. The cultures produced spores in great abundance in 3 days. From the spores the fungus was determined as a species of *Microsporum*.

Two species of this genus, *M. lanosum* Sabouraud[5] and *M. felineum* Fox and Blaxall[6] have been reported as occurring on cats. *Microsporum lanosum* or *Microsporum caninum* Bodin was first observed on dogs, but later reported on cats. *Microsporum felineum* was investigated first by Fox and Blaxall in 1896, who described the transmission of the ringworm from cat to man, but did not name the fungus specifically. This species was reported of frequent occurrence in England but was not found in Paris. Later, in 1902, it was found by Mewborn[7] in New York. The author's use of the name *Microsporum felineum* appears to be the first time it was mentioned in literature. These two species have been considered identical by different authorities, and there is nothing in the descriptions of the microscopic characters of the species to separate them.

The organism studied in the present investigation has been tentatively referred to *M. felineum*. Because of the marked variation observed in the size and shape of the spores in cultures isolated from cats, in the same strains at different ages, and in cultures inoculated into cats and later recovered and re-cultured, it is felt that until a comparative study is made of a large number of strains isolated from cats a specific determination cannot be positive. Comparative examinations were made of strains from cats from Texas, District of Columbia, and New York. The three strains showed a wide range in the spore measurements. The strain from Texas grew slowly and produced smaller, narrower spores than those of the local strain studied by the authors, while the New York strain had spores over twice as long as the latter strain and narrower. In strains from Texas and District of Columbia, the cell walls were not conspicuously muriculate and then only at an advanced stage. The strain from New York showed this character earlier and in a much more marked degree. It is observed that the spores of the organism studied here exceed the measurements for *M. felineum*, but in the different strains studied the size of the spores seemed to vary so much, according to age and vigor, that these differences were not considered sufficiently constant to warrant the establishment of a new species.

[5] SABOURAUD, R. *Trichophyties Humaines*. Atlas, p. 58. Paris. 1907.
[6] FOX, C. and BLAXALL, F. R. Brit. Journ. of Dermatology 8: 377–384. 1896.
[7] MEWBORN, A. D. New York Medical Journal 76: 843–849. 1902.

Cultures made from the scrapings of the human skin and from the scurf of the cat, on Sabouraud and corn meal agar, grew rapidly and fruited in 3 days. The cultures were at first white and fluffy, but later became powdery and deep cream in color. In Petri dishes the fungus showed marked zonations and a tendency to make a secondary growth. The spores were hyaline, spindle-shaped, mostly 7 to 9-septate, and ranged in size from 8–12μ×45–60μ. Old cultures were strikingly pleomorphic and showed an abundance of chlamydospores and so-called aleurispores. No striking morphological differences were apparent in cultures made from the inoculated cats.

It is proposed to assemble various strains of *Microsporum* occurring on cats widely separated geographically in order to make a comparative study of these forms.

PALEOBOTANY.—*A walnut from the Chesapeake Miocene.*[1] EDWARD W. BERRY, Johns Hopkins University.

Fossil plants are extremely rare in the shallow water marine formations of the Middle Atlantic Miocene and, as far as I know, are confined to a very few localities where the near shore deposits of the Calvert—the basal formation of the Chesapeake group—have yielded a limited number of species.

1 2

Fig. 1. *Juglans calvertiana* Berry of Calvert formation, 1½ miles south of Plum Point, Maryland.
Fig. 2. *J. calvertiana* from Richmond, Virginia.

An attempt was made to evaluate these florules in 1916[2] and it was concluded that the one from the District of Columbia with its small-leafed oaks, holly, *Vaccinium*, *Pieris* and Leguminosae represented a temperate flora growing in a region of coastal sand dunes on a low coast with high insolation and slight run-off; and that from Richmond, Va., indicated a low coast lined with cypress swamps where the inconsiderable run-off carried only the finest muds. This past summer

[1] Received Dec. 16, 1933.
[2] BERRY, E. W. *The physical conditions indicated by the flora of the Calvert formation.* U. S. Geol. Survey Prof. Paper 98: 61–73, *pls. 11, 2.* 1916.

Dr. R. L. Collins collected a single compressed nut from Zone 11 of the Calvert formation[3] at a locality 1½ miles south of Plum Point, on the Bay shore in Calvert County, Md. This was collected in place from near the base of Zone 11 which is here a poorly fossiliferous sandy clay about 13 ft. thick, at a point where recent storm waves had washed a new face at the base of the cliff.

At about the same time Mr. Benjamin Gildersleeve working for the Virginia Geological Survey, collected a second specimen from an exposure in the bed of Cannon Creek, 100 ft. north of the Valley road in the city of Richmond, Va. This second specimen was partly weathered out of the matrix and is in two pieces, which enables one to get some idea of the internal morphology.

Although it is not desirable to sacrifice the Maryland specimen to check the internal features, the size, degree of compression, degree of lignification and rather characteristic surface ornamentation leave no doubt that the two fossils represent a nut of the same botanical species and that the internal features of the Virginia specimen may safely be used to amplify the description of the species.

There can be no doubt but that we are dealing with the fruit of some member of the family Juglandaceae and the shape and rugose surface of the specimens point to the genus *Juglans* rather than to *Hicoria*. The seed itself is too shriveled to furnish positive evidence, but the proportions and size of the seed cavity point in the same direction as do the external features.

The species may be called *Juglans calvertiana* and is the first Miocene species from eastern North America. It may be described as follows:

Juglans calvertiana n.sp.

Nut indehiscent, bony, apparently circular in cross-section, with no evidence of any angularities; slightly prolate-spheroidal in form; slightly apiculate—a feature which may have been more pronounced in life than the specimens indicate; rounded at the base; medium thick-walled, irregularly longitudinally rugose, the rather flattened rugosities formed by inosculating and rather deep sulcae.

Seed solitary, fleshy, deeply two-lobed, prominently pointed, too shrunken to show whether it was corrugated as in *Hicoria* or more smoothly excavated as in *Juglans*, seemingly less compressed than in *Hicoria* and with the general proportions of the seeds of *Juglans*.

		Maryland specimen	Virginia specimen
Dimensions:	Length	2.1 cm.	2.05 cm.
	Width	1.8 cm.	1.8 cm.
	Thickness	0.9 cm.	1.3 cm.

[3] Maryland Geol. Survey. Miocene, p. lxxii, 1904.

Regarding the ecological meaning of the specimen a species of *Juglans* hardly fits into the picture of a dune flora or a cypress swamp association, which, as previously mentioned were considered to be the associations of the District of Columbia and Richmond florules respectively.

Insofar as climatic features are concerned *Juglans* accords well with the idea of a temperate flora during the deposition of the Chesapeake group Miocene. That this walnut was not a coastal species, but was carried into the basin of sedimentation by river action seems probable, and while it is remarkable that two specimens from widely separated regions should be found at the same time, the fact that nothing of the sort has hitherto been encountered in all the years that the Calvert exposures have been assiduously collected over by both vertebrate and invertebrate paleontologists points to the actual rarity of such remains and further enhances the probability of the foregoing explanation.

The genus *Juglans* has a fossil record which according to the published accounts goes back to the Mid-Cretaceous and about 150 nominal extinct species have been described. Sixteen Upper Cretaceous species, all from North American localities and all based upon leaflets have been described, but the majority of these must be considered of doubtful botanical validity as the identity of none of the leaflets is confirmed by fossil fruits. The fossil fruits are found however, often in some abundance, in formations ranging in age from the Eocene to the present.

About a dozen Paleocene species are recorded, all North American and all open to some question, and about 26 Eocene all North American or Arctic, except a single European form. The majority of these are based upon leaflets but several fruits have also been found. Oligocene species to the number of 15 have been described and these are all European except one based upon entirely characteristic petrified seeds from the *Titanotherium* beds of Dakota. The absence of North American Oligocene records is to be attributed to the actual dearth of, and the failure to recognize beds of this age on this continent and not to any absence of the genus at that time in North America.

More than 50 Miocene species have been described, the majority of which are European, but Asia, Porto Rico and northern South America appear in the record at this time and many are represented by characteristic fruits. The 14 North American Miocene species are all from the western part of the continent.

About 20 Pliocene species are known, mostly European, although several are from Asia and include many excellent and characteristic fruits. North America does not contribute to the Pliocene record and, as in the Oligocene, this is due to the sparsity of Pliocene deposits which are either marine or are in the arid western part of the continent. Pleistocene species, several of which are apparently extinct, are found in Europe (2), Asia (1), North America (4), and Porto Rico (1). The majority of these are based upon fruits.

ORNITHOLOGY.—*Bird bones from old Eskimo ruins in Alaska.*[1]

HERBERT FRIEDMAN, U. S. National Museum.

In the past few years several valuable lots of Alaskan avian bones have come to the United States National Museum as a by-product of explorations and excavations by members of the Divisions of Anthropology and Ethnology. For convenience in publication and reference, the reports on these collections have been combined into one paper, but each is treated separately herein.

It has been argued at times that bird bones found in old Eskimo habitations are not reliable faunal records as they might have been brought there from quite far off by visiting Eskimos. This, however, is largely negatived by the sedentary habits of almost all the present tribes and village groups of these people.

Not only do these bones (which total hundreds of individual specimens) reveal a little of the "third-dimension" of avian geography, that is, the time duration of present local distribution, but they also yield a number of interesting distributional records, as well as supplying information on the diet of the Eskimos in prehistoric times.

ANCIENT BIRD BONES FROM AMAKNAK ISLAND, ALEUTIAN ISLANDS

The bones reported on below were collected by Mr. Henry B. Collins, Jr., Assistant Curator of Ethnology of the United States National Museum from three ancient Eskimo village sites on Amaknak Island. The exact age of the sites (and therefore of the bones) is not determinable, but according to Mr. Collins their antiquity is very considerable, probably over a thousand years. The village sites are designated by their relative positions—West, East, and Southwest.

Amaknak Island is a small island in Unalaska Bay near the entrance of Captain's Bay, in the northeastern part of Unalaska Island, in the central part of the Aleutian chain. It has a port, Dutch Harbor, where the ships bound for Unalaska generally call, but it has not figured in ornithological literature under its own name to any extent, practically all bird records from there having been recorded merely as "Unalaska Island."

The bones include identifiable remains of 21 species. The majority of these are well known members of the Aleutian, or even Unalaskan, avifauna; two, the yellow-billed loon and the long-tailed jaeger, are of interest as geographic records. Of the bones collected, those in

[1] Published by permission of the Secretary of the Smithsonian Institution. Received March 2, 1934.

sufficiently good condition to be useful as specimens have been retained in the national collections, the fragmentary specimens (unless of interest as records) have not been kept in all cases. An annotated list of the species follows.

GAVIA ADAMSI (Gray) Yellow-billed Loon

The yellow-billed loon is represented by a metacarpal and a tarsometatarsus found in the diggings in the East Village. This species appears to be new to Unalaska Island.

GAVIA STELLATA (Pontoppidan) Red-throated Loon

Two fragmentary humeri were found at the East Village.

DIOMEDEA ALBATRUS Pallas Short-tailed Albatross

A coracoid from the South West Village site (two to three feet down from the surface), and several fragmentary humeri from the East Village (surface down to six feet below) represent this albatross.

PUFFINUS TENUIROSTRIS (Temminck) Slender-billed Shearwater

The slender-billed shearwater is represented by a coracoid found in the surface diggings at South West Village.

PHALACROCORAX PELAGICUS PELAGICUS Pallas Pelagic Cormorant

Two humeri and a fragmentary tarsometatarsus from East Village, a coracoid from West Village, and several humeri and a tibiotarsus from South West Village (surface to three feet deep) reveal the presence of this cormorant on Amaknak Island.

ANSER ALBIFRONS subsp. White-fronted Goose

The white-front goose (probably *gambeli*) is represented by a broken humerus found in the superficial diggings at East Village.

CLANGULA HYEMALIS (Linnaeus) Old-Squaw

One humerus of the old squaw was found at West Village.

HISTRIONICUS HISTRIONICUS PACIFICUS Brooks
Western Harlequin Duck

The western harlequin duck is represented by a humerus from the superficial layer at South West Village, and by another from the deepest layer (four to six feet) at East Village.

SOMATERIA V-NIGRA Gray Pacific Eider

The Pacific eider is represented by bones from three village sites—a tibiotarsus from West Village, a broken tarsometatarsus from South West Village (layer two to three feet deep), and by fragments from East Village (layer three to four feet deep).

SOMATERIA SPECTABILIS (Linnaeus) King Eider

Four fragmentary coacoids from East Village, an ulna from South West Village (superficial layer), and a humerus from the deepest layer (four to six feet) from North East Village belong to this species and indicate the relative commonness of the king eider at Amaknak.

MELANITTA DEGLANDI (Bonaparte) White-winged Scoter

The white-winged scoter is represented by a broken humerus from West Village, four humeri from East Village, and two humeri from the superficial layer of North East Village.

OIDEMIA AMERICANA Swainson American Scoter

A tarsometatarsus from the middle layer (three to four feet deep) from East Village is of this species.

HALIAEETUS LEUCOCEPHALUS ALASCANUS Townsend
Northern Bald Eagle

A broken humerus and a tarsometatarsus from South West Village belong to the Northern bald eagle.

STERCORARIUS PARASITICUS (Linnaeus) Parasitic Jaeger

The parasitic jaeger is represented by a humerus and a tarsometatarsus from East Village, and by a broken tibiotarsus from the deepest layer (four to six feet) from East Village.

STERCORARIUS LONGICAUDUS Vieillot Long-tailed Jaeger

The long-tailed jaeger is represented by five pairs of humeri and one tarsometatarsus from East Village, two humeri and three fragmentary tarsometatarsi from South West Village (surface to three feet deep), and by six humeri (two pair plus two) from West Village.

LARUS HYPERBOREUS Gunnerus Glaucous Gull

A humerus from East Village and a mandible from the middle layer (three to four feet) from East Village represent the glaucous gull.

LARUS GLAUCESCENS Naumann Glaucous-winged Gull

The glaucous-winged gull is represented by a fragmentary humerus from the lowest layer (four to six feet) from East Village.

URIA AALGE CALIFORNICA (Bryant) California Murre

The California murre is listed here on the basis of two humeri from South West Village (two to three feet deep), and a piece of a skull, a humerus, and some fragments from the two lower layers (three to six feet deep) from East Village. This species is very similar to the next osteologically and a number of bones have been considered unidentifiable and are omitted from this report.

URIA LOMVIA ARRA (Pallas) Pallas's Murre

The Pallas's murre is represented by two broken humeri from West Village, a coracoid, two humeri, two femurs, two fragmentary pairs of clavicles, and three ulnae from South West Village (superficial layer), and by nine humeri and three ulnae from East Village. If Salomonsen's new form *inornata*[2] be recognized, these bones would have to be considered as of that race, a course that I consider not unlikely.

CEPPHUS COLUMBA Pallas Pigeon Guillemot

A few fragments of pigeon guillemot bones were found in the superficial layer at South West Village.

LUNDA CIRRHATA (Pallas) Tufted Puffin

The tufted puffin is represented by a humerus and an ulna from East Village.

BIRD BONES FROM OLD ESKIMO RUINS ON KODIAK ISLAND

The following bird bones were collected by Dr. Ales Hrdlicka, curator of Physical Anthropology, United States National Museum, in old Eskimo ruins on Kodiak Island, Alaska, during the summer of 1932. The bones are all in the collections of the Museum.

[2] Ibis, 1932, p. 128: St. Matthew's Island, Bering Sea.

GAVIA IMMER ELASSON Bishop Lesser Loon

One humerus of this loon was collected. The subspecific determination is made on the basis of geography.

COLYMBUS GRISEGENA HOLBOELLI (Reinhardt) Holboell's Grebe

This species is represented by a single humerus.

DIOMEDEA ALBATRUS Pallas Short-tailed Albatross

A tarsometatarsus represents this species in the present collection.

FULMARUS GLACIALIS RODGERSI Cassin Pacific Fulmar

One fractured skull of this bird was unearthed.

PHALACROCORAX CARBO SINENSIS (Shaw and Nodder) Chinese Cormorant

A humerus of this species (subspecies by virtue of geography) is the most surprising discovery in this collection. It comprises not only a great eastern extension of range of this cormorant, but also the first record for the form in North America.

PHALACROCORAX PELAGICUS PELAGICUS Pallas Pelagic Cormorant

The pelagic cormorant is represented by five good and two fragmentary humeri, two ulnae, and one tibiotarsus.

ANSER ALBIFRONS ALBIFRONS (Scopoli) White-fronted Goose

The white-fronted goose is represented by a single humerus in almost perfect condition.

CHEN ROSSI (Cassin) Ross's Goose

A fragmentary skull exactly matches one of this species. This bird appears to be new to the avifauna of Kodiak Island.

CLANGULA HYEMALIS (Linnaeus) Old-squaw

One sternum of this form was collected.

SOMATERIA V-NIGRA Gray Pacific Eider

A single coracoid and two skulls of this eider were collected.

SOMATERIA SPECTABILIS (Linnaeus) King Eider

A humerus and seven skulls of this bird were brought back by Dr. Hrdlicka.

ARCTONETTA FISCHERI (Brandt) Spectacled Eider

This duck is represented by a humerus. It is known to winter in the Aleutian chain and southward.

MELANITTA DEGLANDI (Bonaparte) White-winged Scoter

Nine humeri and three ulnae of this bird were collected.

MELANITTA PERSPICILLATA (Linnæus) Surf Scoter

Of this species five humeri and two ulnae were found.

OIDEMIA AMERICANA Swainson American Scoter

This duck is represented by a broken skull, fifteen humeri, and two ulnae.

HALIAETUS LEUCOCEPHALUS ALASCANUS Townsend
Northern Bald Eagle

The bald eagle is one of the commonest birds of Kodiak Island, and its remains are similarly numerous. It is represented in this collection by nine skulls in various degrees of perfection, one pair of mandibles, four sterna, seven synsacra, thirteen humeri, four ulnae, two radii, five tibiotarsi, two coracoids, one clavicle, one femur, three tarsometatarsi, and twelve metacarpals.

LAGOPUS RUPESTRIS KELLOGGAE Grinnell Kellogg's Ptarmigan

A single humerus of this bird was brought back by Dr. Hrdlicka. The subspecific identification is based on Taverner's data on the distribution of the races of the rock ptarmigan (Ann. Rept. Nat. Mus. Canada 1928: 28–36).

LARUS HYPERBOREUS Gunnerus Glaucous Gull

This gull is represented by four humeri.

LARUS GLAUCESCENS Naumann Glaucous-winged Gull

Five humeri of this gull were collected.

URIA AALGE CALIFORNICA (Bryant) and URIA LOMVIA ARRA (Pallas) California Murre and Pallas's Murre

It is unfortunate that the bones of these two murres are not more diagnostic as both species occur on Kodiak Island. The genus is represented by four skulls, five synsacra, one pair of clavicles, one pair of maxillae, one femur, one ulna, two tibiotarsi, and twenty-three humeri. The probabilities are that the majority of the bones are of *Uria lomvia arra* as that is the commoner of the two murres on the Island.

CEPPHUS COLUMBA Pallas Pigeon Guillemot

A single skull represents this bird in the present collection.

BUBO VIRGINIANUS ALGISTUS (Oberholser) Saint Michael Horned Owl

Dr. Hrdlicka collected six ulnae of a great horned owl, which on geographical grounds, is probably the race *algistus*. It is rather strange that no other parts of the skeleton were found.

SURNIA ULULA CAPAROCH (Müller) American Hawk Owl

A single fragmentary skull represents this species.

CORVUS CORAX PRINCIPALIS Ridgway Northern Raven

This raven is represented by four skulls, one pair of maxillae, two humeri, and two ulnae.

CORVUS BRACHYRHYNCHUS CAURINUS Baird Northwestern Crow

A single humerus of this crow was collected.

BIRD BONES FROM CAPE DENBEIGH, NORTON SOUND

These bones were collected by Mr. H. B. Collins, Jr., from diggings of prehistoric, but probably not very ancient, Eskimo ruins at Cape Denbeigh. The great bulk of the bones are of two species of ptarmigan, *Lagopus rupestris* and *Lagopus lagopus*, both of which were obviously the chief avian items of food (and probably still are) of the local Eskimos. The next most abundant bones are those of Pallas's murre, *Uria lomvia arra*, the white winged scoter, *Melanitta deglandi*, and the Pacific and King eiders, *Somateria v-nigra* and *Somateria spectabilis*. Fifteen species in all are represented in the Cape Denbeigh material, a list of which is as follows:

Gavia adamsi (Gray)	Yellow-billed Loon
Gavia stellata (Pontoppidan)	Red-throated Loon
Phalacrocorax urile (Gmelin)	Red-faced Cormorant
Branta canadensis minima Ridgway	Cackling Goose
Histrionicus histrionicus pacificus Brooks	Western Harlequin Duck
Somateria v-nigra Gray	Pacific Eider
Somateria spectabilis (Linnaeus)	King Eider
Melanitta deglandi (Bonaparte)	White-winged Scoter
Melanitta perspicillata (Linnaeus)	Surf Scoter
Oidemia americana Swainson	American Scoter
Logopus lagopus alascensis Swarth	Alaska Ptarmigan
Lagopus rupestris subsp.	Rock Ptarmigan
Uria lomvia arra (Pallas)	Pallas's Murre
Cepphus columba Pallas	Pigeon Guillemot
Fratercula corniculata (Naumann)	Horned Puffin

BIRD BONES FROM SEWARD PENINSULA

In 1929 Mr. H. B. Collins, Jr., excavated an old Eskimo village at Kowieruk, three miles east of Imaruk Basin, Seward Peninsula. This site was poor in bird bones but revealed fragments of three species:

Gavia adamsi (Gray)	Yellow-billed Loon
Clangula hyemalis (Linnaeus)	Old-squaw
Histrionicus histrionicus pacificus Brooks	Western Harlequin Duck

BIRD BONES FROM BONASILA

In the course of some diggings in an old midden at Bonasila Dr. Hrdlicka unearthed a few bird bones representing the following three species.

CYGNUS COLUMBIANUS (Ord) Whistling Swan

Two broken humeri and one femur.

BRANTA CANADENSIS MINIMA Ridgway Cackling Goose

One humerus and one femur.

MELANITTA DEGLANDI (Bonaparte) White winged Scoter

One humerus.

SCIENTIFIC NEWS AND NOTES

Prepared by Science Service

NOTES

Meeting of the American Chemical Society.—At the spring meeting of the American Chemical Society, held in St. Petersburg, Florida, March 26 to 30, papers were presented by the following Washington scientists: J. E. ADAMS, Bureau of Chemistry and Soils; GEORGE M. BAHRT, Bureau of Chemistry and Soils; FREDERICK BATES, Bureau of Standards; F. G. BRICKWEDDE, Bureau of Standards; C. A. BROWNE, Bureau of Chemistry and Soils; C. K. CLARK, Bureau of Chemistry and Soils; C. C. CONCANNON, U. S. Department of Commerce; J. M. DALLAVALLE, U. S. Public Health Service; E. L. DEMMON, Forest Service; P. H. EMMETT, Bureau of Chemistry and Soils; E. J. FOX, Bureau of Chemistry and Soils; W. A. GERSDORFF, U. S. Department of Agriculture; R. E. GIBSON, Carnegie Institution of Washington; R. M. HANN, National Institute of Health; R. W. HARKNESS, Bureau of Chemistry and Soils; T. H. HARRIS, Bureau of Chemistry and Soils; H. P. HOLMAN, Bureau of Chemistry and Soils; C. S. HUDSON, National Institute of Health; H. S. ISBELL, Bureau of Standards; E. F. KOHMAN, National Canners Association; C. H. KUNSMAN, Bureau of Chemistry and Soils; H. H. MOTTERN, Bureau of Chemistry and Soils; E. K. NELSON, Bureau of Chemistry and Soils; E. M. NELSON, Bureau of Chemistry and Soils; R. A. NELSON, Bureau of Chemistry and Soils; S. PALKIN, Bureau of Chemistry and Soils; G. N. PULLEY, Bureau of Chemistry and Soils; C. B. PURVES, National Institute of Health; D. A. REYNOLDS, Bureau of Mines; N. H. SANBORN, National Canners Association; R. R. SAYERS, U. S. Public Health Service; W. C. SMITH, Bureau of Chemistry and Soils, F. H. THURBER, Bureau of Chemistry and Soils; J. W. TURRENTINE, Bureau of Chemistry and Soils; H. W. VON LOESECKE, Bureau of Chemistry and Soils; J. R. WINSTON, Bureau of Plant Industry, and W. P. YANT, U. S. Public Health Service.

Johns Hopkins University.—The university circular covering 1934 summer courses announces the following Washington scientists as special lecturers for the Summer Research Conferences on Chemical Physics: F. G. BRICKWEDDE, Bureau of Standards; and S. B. HENDRICKS and L. R. MAXWELL, Bureau of Chemistry and Soils.

The Hillebrand prize.—The Hillebrand prize of the Chemical Society of Washington for the year 1933 has been awarded to the late Dr. EDWARD WIGHT WASHBURN for the discovery of the first practical method of separating the isotopes of hydrogen. This discovery, namely, the electrolytic method of separation, has made possible the subsequent research into the properties of the isotopes of hydrogen, and has thus initiated almost a new era in chemistry, consequent upon the differences in the chemical and physical properties of these isotopes and their compounds.

Biological Survey.—Dr. JAY N. DARLING on March 19 took the oath of office as chief of the Bureau of Biological Survey, U. S. Department of Agriculture. Early this year he was awarded the Medal of the Outdoor Life Magazine for outstanding service in the field of wild-life conservation. On June 14, 1933, he was appointed by Secretary WALLACE as a member of the

Advisory Board, Migratory Bird Treaty Act. He has also served as a member of the President's Committee on Wild-Life Restoration.

A recently revised map of the Canadian northwest designates a hitherto unnamed bay on Great Bear Lake as Preble Bay, in honor of E. A. PREBLE of the Bureau of Biological Survey, an early explorer of this region. Mr. Preble had previously been similarly honored when an island 25 miles long in Great Slave Lake was named Preble Island. In North America Fauna No. 27, "A Biological Investigation of the Athabaska-Mackenzie Region," published by the Bureau in 1908, Mr. Preble not only provided the first extensive biological knowledge of this region but also made important contributions to its geography.

Dr. W. B. BELL spoke before a Recreation Conference held March 16 to 18 at the Massachusetts State College, in Amherst, on "The Biological Survey's Contribution to Recreation."

On March 3, F. C. LINCOLN, of the Bureau of Biological Survey, spoke at the annual meeting of the Wilderness Club at Philadelphia, Pa., on *The distribution and migration of some eastern waterfowl.* Mr. Lincoln was recently appointed one of five members of the Waterfowl Committee of the National Association of Audubon Societies.

Bureau of Standards.—Dr. RALEIGH GILCHRIST left on March 14 to attend international congresses on chemistry in Paris and Madrid, as official delegate of the Department of Commerce and of the National Research Council. At the Madrid congress he presented a paper by himself and Dr. E. WICHERS, also of the Bureau's staff, on *A new system of analytical chemistry for the platinum metals.*

Children's Bureau, Department of Labor.—An extensive program has been undertaken for the location of children who are undernourished or in need of medical care. This was first suggested at a national conference called last fall after information assembled by the Children's Bureau had shown many children to be showing effects of the depression. With the aid of C.W.A. funds, thirty-eight states and Puerto Rico set up child health nursing services and employed approximately 2,300 nurses, including 180 supervisors. The Bureau has made available the services of five physicians to assist the states in the development of the program and has prepared special examination forms for use by physicians making examinations of children suspected of being undernourished.

In a majority of the states the lead in organizing the child health recovery program was taken by the state health departments, in a few by the state medical associations, the Academy of Pediatrics, or the state relief administrations. Support of the work has been voted by the American Child Health Association, which lent the part-time services of its medical director for three months, and by the executive board of the American Academy of Pediatrics. Lay organizations of men and women are also assisting.

Department of Terrestrial Magnetism, Carnegie Institution.—R. H. MANSFIELD, who has been stationed at the Huancayo Magnetic Observatory in Peru since September 26, 1932, left the Observatory the latter part of April for Buenos Aires whence he will proceed to Capetown, South Africa. After comparing instruments at the University of Capetown, he will make his way up the east coast of Africa to Aden, Port Sudan, and Suez, securing en route magnetic observations at selected stations previously occupied by observers of the Carnegie Institution of Washington. The principal object of this ex-

pedition is to obtain data for the study of secular variation in the region traversed.

O. W. TORRESON accompanied by Mrs. TORRESON, left Washington on April 6, 1934, for Peru, where he will join the staff of the Huancayo Magnetic Observatory.

Dr. B. J. F. SCHONLAND, Senior Lecturer in Physics, University of Capetown, South Africa, and well known for his investigations of lightning, arrived in New York on April 8, for a ten-week visit in the United States. He plans to spend the first six weeks at the Department of Terrestrial Magnetism. He is to present several papers on the results of some of his recent work at the scientific meetings which will be held in Washington the latter part of April. Before his departure in June, he will visit a number of universities and scientific institutions in the eastern and middle-western states.

Bureau of Fisheries.—At the invitation of the deputy governor of the Federal Reserve Bank of Philadelphia, JOHN S. SINCLAIR, Dr. P. S. GALTSOFF, in charge of oyster investigation for the United States Bureau of Fisheries, presented at the meeting called by the reserve bank, March 27, 1934, an analysis of the present conditions in the oyster industry with special reference to New Jersey.

Dr. GALTSOFF regards the drop in demand for oysters and low prices as being responsible for the present critical situation. Planting operations in Delaware Bay begin in May and end on June 30, but on account of the general economic situation and especially because of the closure of several local banks, the oystermen are unable to obtain credit to finance planting operations. Steps are being taken to obtain credit from the Federal reserve bank.

The sound policy, adopted by the state in maintaining the public seed oyster beds from which planters are permitted to dredge seed oysters for cultivation, is a guarantee that natural oyster resources of the state will not be depleted. This conclusion is corroborated by the fact that from 1880 until 1929 oyster production in New Jersey steadily increased, whereas, in the Chesapeake Bay it materially declined.

At the request of the New York State Conservation Commissioner, LITHGOW OSBORNE, a conference was held by the representatives of the state and officers of the United States Bureau of Fisheries at Cambridge, Mass., on March 21, for the purpose of laying plans for a cooperative investigation of the marine fisheries of New York. As a result of the very definite increase in interest among anglers, particularly in the fishery resources of the marine district, the conservation department is considering the possibility of undertaking an intensive study of the fish supply in order to provide for adequate utilization as well as conservation. Dr. EMMELINE MOORE, chief aquatic biologist of the conservation department, presented the tentative plans of the state's investigation, and R. A. NESBIT, in charge of the Bureau's investigations in the Middle Atlantic section, discussed at length the findings of four years of research by himself and several assistants in this field.

PERSONAL ITEM

DELBERT M. LITTLE, for the past five years in charge of the Weather Bureau's station at Oakland, Calif., has been promoted to the chief of the aerological division of the Bureau.

DO NOT REMOVE